

REMARKS

The Examiner is thanked for the very thorough and professional Office Action and the provisional allowance of Claims 12 and 13 if rewritten in independent form. Pursuant to the Office Action, Claims 1, 3, 6, 7, 17, 25, and 26 have been canceled and Claims 2, 4, 5, 8, 10, 12, 14, 16, 18, 22 and 24 rewritten to more definitely set forth the invention and obviate the rejection.

Claim 8 has been rewritten by combining original Claim 8 with Claim 1, and the lower limitation of Cr content has been narrowed according to the composition of the embodiment shown in the Specification, Table 5, on page 46. More particularly, steel No. 118 in Table 5 contains Cr in an amount of 4.24 wt%, i.e., the lower limitation of Cr in Claim 8. The reason for this limitation is that Cr forms carbide to thereby enhance the matrix strength and improve wear resistance. Further, Cr improves hardenability and, therefore, in the free-cutting tool steel according to Claim 8 the Cr content of 4.24 wt% is claimed to assure sufficient wear resistance and hardenability of the tool steel.

Further, Claim 10 has been combined with Claim 1 and the further lower limitation of C content narrowed in accordance with the composition of the embodiment shown in Table 8, page 51, of the Specification. More specifically, steel No. 218 in Table 8 contains C in an amount of 0.51 wt%, i.e., the lower limitation of C in the amended Claim 5 10. The carbon is an element which is contained in the Ti-base machinability improving compound phase, and C can be solubilized in matrix to improve the hardenability of the steel and also impart wear resistance.

Claim 14 has been amended to combine it with original Claim 1. Additionally, Claim 12 has been rewritten to incorporate the subject matter of original Claim 1, and it is 10 therefore believed that Claims 12 and 13 are now in condition for allowance.

Also, new Claim 37 has been written by combining original Claims 16, 17 and 26 and the further lower limitation of C content according to the composition of the embodiment shown in Table 25, Specification, page 78. More specifically, steel No. 32 shown in Table 25 contains C in an amount of 0.033 wt%. Carbon is an element which is 15 contained in the Ti-base machinability improving compound phase as well as being an

element solubilized in matrix to improve hardness and wear resistance of the steel.

Therefore, in the free-cutting tool steel according to Claim 37, it is necessary to make the

lower limitation of C content 0.033 wt% to achieve the necessary amount of machinability

improving compound and additionally assure sufficient hardness and wear resistance of

5 the tool steel. The present amendment is deemed not to introduce new matter. Claims 2,

4, 5, 8-16, 18-24, and 27-45 are in the application.

Reconsideration is respectfully requested of the rejection of Claims 1-11, 14-25 and

27 under 35 U.S.C. § 103(a) as being unpatentable over Watari, et al.

Watari, et al. fail to disclose compositions which provide a tool steel having the

10 properties of the tool steel of the present invention in a number of respects. First, there is

no disclosure whatever in Watari, et al. of providing a tool steel composition which will

assure sufficient hardness and wear resistance as a tool steel by aging precipitation.

Further, the Al content in all of the alloy compositions disclosed in Tables 1-4, 9, 11 and

13 of Watari, et al. fail to meet the requirements of the free-cutting tool steel now called

15 for in Claim 16 herein. Further, the Cr content in all of the alloy compositions of Watari,

et al. fails to meet the requirements of the free-cutting tool steel according to new Claim

37.

Moreover, Watari, et al. fails to disclose forming Ti-base machinability improving

compound phase that is not elongated in the direction of forging and rolling even though

5 rolling or forging are performed, thereby suppressing the degradation of toughness in the

T-direction, i.e., the direction normal to the direction of forging and rolling. This

property of the tool steel of the present invention imparts excellent toughness with

minimal anisotropy.

In view of the foregoing and the extensive amendments of the claims herein, it is

10 respectfully submitted that Watari, et al. in no way anticipate or render unpatentably

obvious the subject matter of the claims as amended. For this reason, it is respectfully

submitted that the Examiner would be justified in no longer maintaining the rejection.

Withdrawal of the rejection is accordingly respectfully requested.

Reconsideration is respectfully requested of the rejection of Claims 16-27 under 35

15 U.S.C. § 103(a) as being unpatentable over Leban, Japanese Patent 9-296221 (hereinafter

'221 patent), Japanese Patent 8-260107 (hereinafter '107 patent), Honkura, et al., or Saito, et al.

The Leban reference while suggesting imparting machinability to steel by the addition of Ti and Zr, the purpose of adding these elements is not related to the formation 5 of Ti-base machinability improving compound phase. Moreover, there is no disclosure whatever in Leban of a composition to achieve the three objects of the present invention, i.e., (1) to impart excellent level of machinability, (2) to assure sufficient hardness and wear resistance as a tool steel, and (3) to impart excellent toughness with minimal anisotropy by intentionally forming Ti-base machinability improving compound phase in 10 steel according to the present invention.

In the alloy compositions A, B, and C disclosed in the Table, columns 3 and 4, of Leban, X / Y (i.e. $(W_{Ti} + 0.52W_{Zr}) / (W_S + 0.4W_{Se} + 0.25 W_{Te})$) amounts to lower than 1. Therefore, Leban fails to meet the requirement of the free-cutting alloy according to Claims 16 and 37 herein. Accordingly, the Leban reference fails to anticipate or render 15 unpatentably obvious the formation of sufficient Ti-base machinability improving

compound phase and the improvement of machinability of the present invention.

Honkura et al disclose the addition of Ti, but the purpose of the addition is related with neither the formation of Ti-base machinability improving compound phase nor of imparting machinability. Honkura et al. fail to disclose a composition which achieves 5 applicant's three objectives by intentionally forming a Ti-base machinability improving compound phase in steel. Further, the contents of Cr, Al, Ni and Cu in all the alloy compositions A to U disclosed in Table 1 of Honkura et al do not meet the requirements of the free-cutting tool steel according to Claim 16 herein. Further, all the composite alloys disclosed in Table 1 of Honkura et al do not meet the requirements regarding the C content, 10 or the X/Y of the free-cutting tool steel according to Claim 37 herein.

Saito et al disclose the addition of Ti, but the purpose of the addition is not related to either the formation of a Ti-base machinability improving compound phase or imparting of machinability. Saito et al. fail to disclose a composition which achieves applicant's three objectives by intentionally forming a Ti-base machinability improving compound 15 phase in steel as disclosed by applicants. Among the alloy compositions disclosed in table 1 of Saito et al, the alloy composition Nos. 9, 10 and 12 contain S or Se. However, the contents of the Cr, Ni and Cu in the alloy compositions of Saito et al do not meet the requirements of the free-cutting tool steel according to Claim 16 herein. Further, the contents of C in the alloy compositions of Saito et al do not meet the requirements of the 20 free-cutting tool steel according to Claim 37.

Although forming of a Ti-base machinability improving compound phase is disclosed in JP9-296221, there is no disclosure of a composition to achieve the objects of the applicants' invention, i.e. imparting of machinability, assuring sufficient hardness and wear resistance of a tool steel by aging precipitation and imparting excellent toughness
5 with minimal anisotropy.

The content of Al in the alloy compositions A to G disclosed in Table 1 of JP'221 does not meet the requirements of the free-cutting tool steel according to Claim 16 herein. Further, the content of C in the above alloy compositions of this reference does not meet the requirements of the free-cutting tool steel according to Claim 37 herein.

10 In addition, the JP '221reference does not disclose another feature of the applicants' invention, i.e., forming a Ti-base machinability improving compound phase that is not elongated in the direction of forging-and rolling even though rolling or forging are performed, thereby suppressing the degradation of toughness in T-direction (the direction normal to the direction of forging and rolling), to achieve the object 3, i.e. in
15 order to impart an excellent toughness with minimal anisotropy.

Although the forming of a Ti-base machinability improving compound phase is disclosed in JP8-260107, there is no disclosure therein of a composition to achieve the objects of the applicants' invention, i.e. imparting of machinability, assuring sufficient hardness and wear resistance as a tool steel by aging precipitation and imparting excellent
20 toughness. The contents of Al, Ni, Cu and Cr in the alloy compositions 1 to 17

disclosed in Table 1 of JP'107 do not meet the requirements of the free-cutting toll steel according to Claim 16 herein.

Further, the content of C in the above alloy compositions of the JP '107 reference does not meet the requirements of the free-cutting tool steel according to Claim 37 herein.

- 5 In addition, the JP '107 reference does not disclose another feature of the applicants' invention, i.e., forming a Ti-base machinability improving compound phase that is not elongated in the direction of forging-and rolling even though rolling or forging are performed, thereby suppressing the degradation of toughness in T-direction (the direction normal to the direction of forging and rolling), to achieve object 3, i.e. in order to impart
10 an excellent toughness with minimal anisotropy.

There is no disclosure or suggestion in the foregoing cited references to achieve applicant's three objects by intentionally forming a Ti-base machinability improving compound phase in steel. Further, the cited references do not disclose the specific alloy composition which satisfies the compositions called for in Claims 16 and 37 herein.

- 15 Accordingly, Claims 16, 18-24, 27 and 37-45 shall not be rejected under 35 USC§103 (a) since the invention was not expected to a person having ordinary skilled in the art from the cited references.

Patentability of an alloy can be based on the elements thereof or the proportions thereof if the elements or proportions produce new results from new proportions, a new

metal or an old metal with new characteristics of structure or performance, embracing new or at least substantially enhanced qualities of utility. Darwin and Milner, Inc. v. Kinite Corp., et al., 22 USPQ 61 (CA 7, 1934).

Where difficulties in balancing the properties and compositions of related alloys has
5 been acknowledged in the prior art, an alloy having enhanced properties (combination of high strength and ductility) would be unobvious from the prior art. In re Tanczyn, 146 USPQ 298 (CCPA, 1965). The physical distribution of an element in an alloy can impart patentability to the alloy. Ex parte Hine, 154 USPQ 49 (POBA, 1967).

In the present case, applicants have provided a free-cutting steel having excellent
10 machinability which is less causative of anisotropy in mechanical properties, particularly in toughness, depending on forging and rolling direction. This is achieved by providing a free-cutting steel having dispersed in a texture thereof a machinability improving compound phase. It is therefore apparent from the examples set forth herein that the steel composition of the present invention exhibits enhanced properties which are nowhere
15 disclosed in any of the prior art of record. For this reason, it is respectfully submitted that

the rejection fails, as a matter of law, in view of the above authorities. Consequently, the Examiner would be justified in no longer maintaining the rejection. Withdrawal of the rejection is accordingly respectfully requested.

In view of the foregoing, it is respectfully submitted that the application is now in
5 condition for allowance, and early action and allowance thereof is accordingly respectfully
requested. In the event there is any reason why the application cannot be allowed at the
present time, it is respectfully requested that the Examiner contact the undersigned at the
number listed below to resolve any problems.

Respectfully submitted,

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